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METHODS OF PRESENTING STATISTICS OF WAGES.*

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American statisticians have introduced two important improvements in methods of presenting statistics of wages. In 1884 President Carroll D. Wright, then Labor Commissioner of Massachusetts, employed classified wage-tables to present the pay of working-girls in Boston, and in the next two or three years he elaborated this device, and used it extensively. Several years later Professor Roland P. Falkner, acting as statistician of the Senate Committee that published the great report on Wholesale Prices, Wages, and Transportation, made the first use of index numbers in preparing tables of wages.†

These two methods are so far superior to the methods formerly used that in recent years one or the other of them has commonly been adopted by competent investigators dealing with wage statistics. Notable examples are supplied by the

* The tables in this article have been prepared with the aid of appropriations granted by the Carnegie Institution. To the institution and its officers, especially to Professors Davis R. Dewey and Henry B. Gardner, I owe hearty thanks.

† President Wright has himself pointed out that the "first step" in the direction of the classified wage-table was taken by his predecessor in office, General Henry K. Oliver. See "The Evolution of Wage Statistics," *Quarterly Journal of Economics*, vol. vi, p. 164. Professor Falkner also has called attention to the fact that his innovation had been anticipated. Sir Robert Giffin suggested the application of index numbers to wages in 1887. See "Wage Statistics in Theory and Practice," Publications of the *American Statistical Association*, vol. vi, p. 287.

two elaborate investigations into wages in the United States, lately published by the Census Office and the Bureau of Labor. In the former investigation, Professor Davis R. Dewey's special report on "Employees and Wages," classified wage-tables are used. Professor Dewey, however, has improved upon the earlier form of these tables by introducing cumulative percentages, medians, and quartiles to facilitate interpretation and comparison. In the latter investigation, the general results of which have been published in the Bulletins of the Bureau of Labor, Falkner's example in using index numbers is followed. But the Bureau also has improved upon its model, both by increasing the scope of the data and by correcting and extending the analysis in certain details.

This concurrent use of both methods does not result from differences of opinion about their relative merits, but from differences of purpose or in the character of the materials available for analysis. Indeed, it is hardly proper to ask which method is the better. For a statistical method is a means of dealing with certain material to accomplish a certain end, and a method that is an excellent means to one end when the material is of one sort may be a poor means to an end slightly different, or even to the same end when the material is different.* Such is clearly the case in the present instance. In some uses classified wage-tables as perfected by Dewey are much better than tables of relative wages. In other uses they are not so good.

When the purpose is to show the wage-rate of any group of employees at any one time or at different times, classified wage-tables are the best device for presenting the complicated facts in simple form. Falkner's method, on the contrary, cannot be used at all for such purposes, since it does not show

* The statement of this commonplace may be pardoned, because statisticians are prone to discuss methods without reference to the diverse purposes for which the methods are employed. The tedious discussion of the relative merits of "simple" and "weighted" averages is an example. Most of what has been published upon this subject might have been spared, had the writers stated clearly, even to themselves, for what purposes the averages were to be used. For then it would have been clear to all that in some cases "simple" and in other cases "weighted" averages are preferable.

actual wages, but relative wages only. On the other hand, when the purpose is to exhibit how wages have changed, either method can be used. But there is an important difference between the ways in which the two methods show change of wages. Classified wage-tables like Dewey's show change in average wages, with medians and quartiles as the averages. Index numbers like those of the Bureau of Labor show average change in wages, with arithmetic means of relative wages as the averages.

Of these two things—change in average wages and average change in wages—the former is doubtless the more significant for most purposes; but it is also the more difficult to measure satisfactorily. For satisfactory measurement of change in average wages requires the construction of satisfactory averages of wages for each period covered by the investigation, and to construct such averages is exceedingly difficult. On this point Professor Dewey's course in preparing his report on "Employees and Wages" is highly instructive. In the first place, he did not attempt to cover the whole field of wage-payments, but restricted his investigation to thirty-four stable manufacturing industries. Further, he treated each one of these selected industries by itself, refraining from any attempt to make a summary exhibit for all his industries together. Finally, in discussing each separate industry, he did not make precise quantitative statements of the degree of change in wages between 1890 and 1900, but expressed his conclusions in such phrases as "a marked increase in wages," "a slight decrease," "little change."* Had he regarded his medians as satisfactory averages of wages, he might have computed the exact ratio of change for each industry at least. His unwillingness to use his medians in this way, and his unwillingness even to publish medians for groups larger than single industries, is impressive evidence of the difficulty which competent statisticians feel in measuring change in average wages.

* See "Employees and Wages," chap. ii, especially p. xcix.

Toward measurements of average change in wages the attitude of statisticians is somewhat different. Tables of index numbers for large groups are computed and accepted with more confidence than are tables of average wages. It is true that the results obtained by the pioneer in this field are now generally discredited; but the reason is not lack of faith in his method, but objections to the way in which he applied it in details. In contrast, the new index number tables of the Bureau of Labor have been received with favor,—indeed, with more favor than they merit.*

I do not know that the reason for this difference of attitude toward the two ways of measuring change in wages has ever been stated. It clearly rests upon a current belief that from a given body of wage-data for two periods of time a nearer approximation can be obtained to the average change in wages than to the change in average wages. In favor of this belief the following argument may be advanced. All large collections of wage-data show less divergence in the degree of change in wages in different occupations from one time to another than in the degree of variation in the wages paid in different occupations at the same time.† Hence the inevitable failure to obtain uniform data for all important groups invalidates less seriously the representative character of the average change in wages computed from the material that is obtained than it invalidates the representative character of average wages computed from the same material. In other words, the probability is greater that the average change in wages in the unknown groups differs little from the average change in the known groups than that the average wage in the unknown groups differs little from the average wage of

* An error in the method of constructing averages in these tables is pointed out below.

† *E.g.*, an examination of Tables I and II in the Bulletin of the Bureau of Labor for July, 1905, shows that the extreme range of fluctuation in relative wages in 1904 is less than 100 points, while the highest rate per hour for that year is more than 1,000 per cent. of the lowest rate. The extremes are: for relative wages, 75.1 (leather-stakers, male) and 171.4 (building trades,—structural iron workers); for actual rates per hour, $0.0638 (cotton spinners, frame, male) and $0.6706 (iron and steel rollers).

the known groups. Therefore, material that careful statisticians would not regard as affording sufficient basis for stating average wages they may use as a basis for estimating average change in wages.

In deciding which method to use for measuring change in wages, then, one must consider whether one's material justifies a statement of average wages for the groups one wishes to treat, and also whether an estimate of average change will not serve one's purpose. I have recently had to consider these questions in connection with a study of the economic effects of the paper standard in the United States during the years 1862 to 1878. One important branch of the inquiry is the effect of the paper standard on the economic interests of wage-earners. The point of interest is not so much the actual economic status of American workingmen as it is the alteration made in that status by the substitution of the greenback for the gold dollar. Hence estimates of the average change in the rates of pay serve the purpose of the investigation as well as would estimates of change in the average rates of pay. Moreover, the available collections of wage-data are not very extensive. The best collection —that contained in the exhibits of the Aldrich Report—gives data for only 21 industries, among them some of slight importance and others represented by but few returns. The total number of persons whose rates of pay are reported with approximate regularity varies from a little over 4,000 to a little under 8,000 in different years of the paper-standard period. This material is clearly not sufficient to justify the computation of average wages even for manufacturing industries. But, for the reason that has been set forth, one has greater confidence in the estimates of average change in wages that may be obtained from it. For such a study, based on such materials, it seems certain that Falkner's method is to be preferred.

One can borrow from Falkner, however, only the general idea of using index numbers to present statistics of wages. In the detailed application of this method Falkner was him-

self singularly unfortunate. Critics of the Aldrich Report have made the errors committed in compiling its now celebrated table of relative wages so familiar that there is no need to repeat their strictures.* Unfortunately, it must be added that in the application of the method the Bureau of Labor also commits blunders which prevent one from taking its table as a model. For the Bureau has borrowed from Falkner not only his general plan, but also his most serious error. Falkner treated every series of relative wages as having the same importance whether it represented the pay of one man or of a thousand men. As Professor C. J. Bullock has pointed out, this course allows an importance to the wages paid each individual varying inversely as the number of persons included in the series to which he belongs. "Where 20 men are included in a series, the quotation for each man receives one-twentieth of the weight that is given to another series that represents the earnings of a single workman."† The Bureau of Labor's way of treating numbers employed is a curious compromise between this error and the proper method. From its original data it first constructed series showing the relative rates of pay of all persons reported as following a single occupation in a single industry. In making these averages for occupations each original series was weighted according to the number of persons whose pay it represented. But, when the Bureau proceeded to compute averages for the industries from the averages for the various occupations, it treated each occupation as having the same importance whether it represented the pay of half a dozen men or of several thousand. This procedure, of course, reintroduced the old error into the averages for the industries. It is equally matter of course that, once the error was embodied

* A recent review of the defects of Falkner's procedure, together with references to earlier criticisms, is given by Miss Edith Abbott in "The Wages of Unskilled Labor in the United States, 1850–1900," *Journal of Political Economy*, June, 1905, vol. xiii, pp. 340–350.

† C. J. Bullock, "Contributions to the Study of Wage Statistics," *Publications of the American Statistical Association*, March, 1899, vol. vi, pp. 213, 214.

in the averages for the industries, it was not eliminated from the grand averages for all industries by weighting the series for the industries by amount of wages paid, by the numbers of workmen employed, or by any other amounts.*

In making tables of the type of those of the Bureau of Labor, then, one can effect an important improvement in the treatment of numbers employed. If the results are used as an estimate of the average change in the rates of pay of all the persons included in the investigation, each series ought to receive a weight in making up all the averages into which it enters, determined by the number of persons whose relative wages it represents. Other improvements in method of presentation, the reasons for which need not be set forth at length, are the preparation of separate summary tables for males and for females, and also for the more important occupations, whose members make in a sense distinct economic units, though they are employed in establishments belonging to different industries; *e.g.*, machinists, engineers, etc. Finally, it is desirable to supplement the classifications by

* The manner in which the averages shown in the tables were computed is not explained in the text of the Bulletins. I owe the explanation regarding the averages for occupations to the kindness of Mr. G. W. W. Hanger. That weights for numbers employed were neglected in making averages for the industries, any one can prove for himself by a few trials with the published figures. To test the effect of this error in method upon the results, I have recomputed the average relative wages per hour in 1903 for several industries, weighting each occupation according to the average number of persons reported as employed in it during the years 1890–1899. The results compare as follows with the figures given in the Bulletin:—

Industry.	Weighted Average.	Bulletin Average.
Agricultural implements	113.8	117.2
Bakery, bread	116.6	118.8
Building trades	125.4	126.4
Candy	112.2	109.3
Clothing, factory product	109.9	106.7
Clothing, men's, custom work	110.0	111.1
Cooperage	114.4	125.2
Cotton	117.2	123.1
Fruits and vegetables, canning	106.4	106.0
Liquors, malt	119.2	120.3
Lithographing	107.9	107.3
Oil, cotton-seed	102.1	105.2

sex, industry, and occupation, by a classification based on amount of actual wages. For, in important respects, laborers receiving low rates of pay form an economic group distinct from that of the better-paid craftsmen.

After one has determined how to treat numbers employed, and has settled upon the various ways in which to classify the wage-series, one has still to decide upon the manner of presenting the results for the groups constituted. The traditional method is to compute from the individual series of relative wages series of averages, and to present these latter series as adequately representing the changes that have occurred. Usually, the averages are arithmetic means; but sometimes geometric means, medians, or modes are used instead. There is no occasion here to discuss the relative advantages and disadvantages of these various forms of averages. Writers on statistical method have made them familiar. But attention must be called to the fact that a clear idea of the diverse changes that take place from time to time in the pay of any large group of wage-earners can be obtained from none of these forms. No two numbers can possibly give such an idea to a reader. Objections like those so effectually urged by President Wright against accepting a single average of actual wages, however computed, as a sufficient statement of the complex facts of the wage situation at any period, may be urged against accepting a single average of relative wages, however computed, as a sufficient statement of the complex facts of wage-changes between two periods. Indeed, statisticians recognize that averages may give a faulty impression of the facts they are supposed to represent, and that, when possible, it is desirable to provide a fuller exhibit than the averages afford. This fuller exhibit always has the advantage of increasing the reader's knowledge of the facts. When the average alone would be misleading, this fuller exhibit supplies a corrective. When the average alone would be fairly representative, the fuller exhibit es-

tablishes confidence in its representative character. Finally, the deviations from the average and the distribution of these deviations are facts of significance that deserve more attention than they have commonly received.

Granted that in presenting statistics of wages it is desirable to show more of the facts than any of the usual forms of average can show, the problem remains of devising the best way of so doing. One naturally thinks first of tables of frequency,—a familiar device for showing the distribution of statistical measurements of various kinds. Such tables can be adapted to the present task by treating the relative wages as one set of quantities, and the number of persons receiving each relative wage as another set. From such tables simple diagrams—frequency surfaces—can be drawn to represent the facts graphically.

Both the advantages and the limitations of this method of presenting relative wages can best be appreciated from examination of the specimen table on pages 10–11, which is constructed from data contained in the exhibits of the Aldrich Report. All the series in this report, giving fairly complete data for wages and number of employees in January and July of the years 1860 to 1880, have been copied, and the actual wages reduced to relative wages on the basis of the actual rates of pay in 1860.* Tally-sheets were then made for each date showing in regular order the relative wages received by all the persons included, and opposite each relative wage the number of persons receiving it. The range of relative wages during this period of great monetary changes was so wide, and the tally-sheets were in consequence so long, that compression had to be effected before the results for all the dates could be presented within manageable com-

* The series of one industry—city public works—were excluded from this table, (1) because the number of employees varied widely on different dates, ranging from nearly two-thirds to less than one-twentieth of the number of employees in the remaining twenty industries; (2) because in this country municipal employees are not often paid strictly on a business basis, and to include them in a general average therefore injures the representative character of the results as exhibiting the average change in the pay of the great mass of private employees.

EMPLOYEES IN MANUFACTURING INDUSTRIES ARRANGED ACCORDING TO RELATIVE WAGES RECEIVED IN JANUARY AND JULY OF THE YEARS 1860 TO 1880

(The figures show the percentages borne by the numbers of persons receiving the relative wages, indicated by the scale on the left to the whole number of persons employed. Wages in 1860=100.)

	1860.		1861.		1862.		1863.		1864.		1865.		1866.		1867.		1868.		1869.		1870.
	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.
Number of Persons.	3,683	3,972	3,519	3,922	3,595	3,723	3,060	3,749	3,929	4,457	3,960	4,328	4,643	4,931	5,183	4,989	4,587	4,976	4,862	5,555	5,505
Relative Wages.	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
50–9	—	—	—	—	—	—	.1	.1													
60–9	—	—	—	—	2	—	.1	.2	—	—	.1	—	—	—	—	—	—	—	.1		
70–9	—	1.3	1.3	1.4	1.4	.8	.2	.2	.1	.1	.1	.3	—	.1	.1	—	.1	—	—	—	.3
80–9	—	1.2	4 8	6.5	5.5	8.6	2.7	1.0	.4	.3	.6	.2	.1	.2	.4	.6	.4	.4	.4	.4	.1
90–9	—	20.0	22.6	27.6	25.2	18.5	9.8	4.7	5.9	3.0	1.1	.5	.2	.1	.3	—	.1	.1	.1	.2	.3
100–9	100.0	73.5	57.6	46.3	49.1	42.3	38.8	29.5	14.1	11.4	3.1	1.6	1.7	1 1	.6	.6	1.1	1.1	.7	.6	1.0
110–9	—	3.4	6.8	9.7	8.5	18.1	23.4	32.3	18.3	8.8	8.2	4.5	3.1	1.3	1.7	1.9	1.0	1.5	1.4	1.9	2.3
120–9	—	.7	3.1	6.8	5.3	5.2	8.3	14.3	20.8	15.7	10.7	7.3	5.9	4.7	3.7	2.8	4.0	2.2	2.7	2.3	2.2
130–9	—	.9	.6	1.3	4.2	4.1	4.1	3.9	15.2	19.2	14.7	15.3	7.6	6.6	5.3	5.0	5.7	5.7	5.0	3.6	4.9
140–9	—	—	3.2	.4	.1	1.9	8.0	6.8	9.3	13.1	13.8	15.6	14.3	12.3	12.1	10.6	11.4	10.3	9.2	8.1	6.2
150–9	—	—	—	—	.1	.1	.7	1.5	5.1	12.0	19.7	22.3	15.1	25.6	14.2	17.8	12.4	13.9	13.5	11.0	12.5
160–9	—	—	—	—	.2	.2	.6	2.3	6.1	9.8	8.8	14.5	13.5	10.0	8.8	19.4	18.5	13.5	12.0	12.2	11.3
170–9	—	—	—	—	—	—	—	.6	1.0	4.8	9.2	9.0	21.7	17.7	17.4	11.7	18.8	18.1	17.3	17.2	15.8
180–9	—	—	—	—	.1	.1	3.0	2.1	1.1	.7	7.9	6.6	11.8	14.1	27.3	16.1	15.2	17.9	13.0	12.5	15.2
190–9	—	—	—	—	—	—	—	—	—	.8	1.0	.9	2.4	2.3	3.3	4.5	3.7	4.5	6.4	1.9	7.5
200–9	—	—	—	—	.1	.1	.1	.3	2.5	.1	.7	1.1	1.9	3.2	3.6	6.2	5.4	6.1	11.5	11.4	13.2
210–9	—	—	—	—	—	—	—	—	—	—	.1	.1	.3	.3	.9	1.4	.5	1.5	1.3	8.6	2.5
220–9	—	—	—	—	—	—	—	—	—	—	—	—	.2	.1	.3	1.0	1.3	1.8	4.0	4.9	3.4
230–9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.9	.2	.4	.1
240–9	—	—	—	—	—	—	.1	.2	—	—	—	—	.1	.1	—	—	—	—	—	.7	.1
250–9	—	—	—	—	—	—	—	—	—	—	.1	.1	—	—	—	.3	.3	.3	1.0	1.6	.8
260–9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.1	.1	.1
270–9	—	—	—	—	—	—	—	—	—	—	—	—	.1	.1	—	—	—	—	—	—	—
280–9	—	—	—	—	—	—	—	—	.1	.2	—	—	—	.1	—	.1	.1	.2	.1	.2	.1
290–9																			—	—	—
300–9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.1	—
310–9																					—
320–9	—	—	—	—	—	—	—	—	—	—	.1	.1	—	—	—	—	—	—	—	.1	.1

TABLE I.—CONTINUED.

	1870.	1871.		1872.		1873.		1874.		1875.		1876.		1877.		1878.		1879.		1880.	
	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.	Jan.	July.
Number of Persons.	5,463	5,303	5,799	5,259	6,130	5,180	5,428	5,098	5,181	4,617	5,068	4,341	5,070	4,710	5,200	4,691	5,186	4,864	5,504	5,367	6,183
Relative Wages.	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
50–9	—	—	—	—	—	—	—	—	—	—	—	.5	.4	.4	.3	.4	.4	.3	.2	.2	
60–9	—	—	—	—	—	—	—	—	—	.5	.4	.1	.1	—	.1	.2	.1	—	—	—	.2
70–9	.4	.5	.4	.1	—	—	—	.4	.4	—	—	.1	.1	.1	.3	.2	.1	.2	.2	.6	.4
80–9	.3	.3	.3	.7	.5	.7	.7	.6	.4	.4	.5	.7	.7	.6	.5	.6	.4	1.9	1.0	.5	.2
90–9	.5	.4	.1	.1	.1	.3	.1	.2	.3	.7	1.0	.9	.7	1.3	1.1	1.6	1.0	1.5	2.1	1.5	1.6
100–9	1.0	.8	.7	1.2	.7	.6	.7	.9	.9	1.4	1.4	2.0	2.3	2.2	3.2	3.9	4.0	4.1	3.1	3.6	3.4
110–9	1.9	2.1	2.1	2.6	2.0	2.3	1.7	2.1	1.2	2.0	1.8	2.3	2.9	6.5	8.9	6.9	8.6	9.0	10.0	7.0	5.6
120–9	2.5	2.6	2.4	2.6	2.9	3.0	3.5	4.2	3.6	4.4	3.5	7.0	11.3	14.0	13.9	16.4	16.4	21.3	23.5	22.3	15.4
130–9	6.7	4.9	4.3	4.7	4.0	4.6	4.3	3.6	3.9	6.7	7.3	8.4	16.5	12.5	17.8	12.6	18.4	11.0	13.3	16.5	19.1
140–9	6.2	5.4	5.1	6.0	4.5	6.7	5.1	10.4	8.4	14.6	16.3	18.0	12.4	18.3	18.6	15.6	17.3	18.1	15.0	14.2	13.3
150–9	10.4	10.6	10.5	11.9	10.7	12.9	11.3	13.7	12.1	12.5	14.1	14.2	18.4	19.5	11.2	14.6	9.0	7.4	9.5	6.9	15.0
160–9	11.0	12.5	11.2	11.0	9.4	12.0	10.8	13.4	12.5	17.7	20.9	12.0	12.8	7.5	10.4	10.3	8.9	8.6	7.4	10.0	9.9
170–9	19.8	15.0	14.0	18.9	15.2	12.9	15.2	9.7	17.4	15.9	12.9	16.3	10.2	8.5	7.1	9.2	8.5	8.9	6.9	9.2	8.0
180–9	15.3	10.8	10.1	7.8	9.8	18.3	12.4	18.6	17.8	7.4	7.8	7.3	3.7	2.2	3.5	1.9	2.3	2.8	4.3	3.3	2.0
190–9	2.5	19.5	17.4	8.9	9.9	6.6	6.2	6.2	5.9	6.0	4.5	3.1	4.0	1.9	.2	1.2	.1	—	.1	.1	1.6
200–9	14.0	5.5	11.5	10.0	18.9	8.5	8.7	7.1	7.3	5.4	3.8	2.6	1.4	1.4	.9	1.3	2.6	2.3	1.4	1.7	2.7
210–9	2.3	1.9	2.7	4.5	3.2	2.6	8.0	2.6	4.1	.6	.6	.3	.2	.8	.5	.6	.5	2.4	.8	16.6	.6
220–9	2.9	4.7	3.1	4.8	3.4	1.9	5.2	3.0	1.0	.5	1.2	1.0	1.1	2.0	.9	2.1	.3	.1	1.1	—	.8
230–9	.2	2.0	1.3	1.7	.4	.4	1.9	.1	—	.3	.2	.5	.5	.1	.5	.3	.9	—	—	.7	.1
240–9	1.0	.1	—	.1	.8	1.7	1.0	—	.2	2.4	1.1	2.6	.2	.1	—	—	.1				
250–9	.7	.1	.8	.1	1.9	1.2	.5	.7	1.4	.6	.7	.1	.1	.1	.1	.1	.1	—	—	.1	.1
260–9	.1	—	1.6	—	—	—	1.0	2.4	1.2	—	—	—	—	—	—	—	—	.1	.1		
270–9	—	—	—	1.5	—	—	.9														
280–9	.2	.1	.2	.1	.2																
290–9	—	—	—	.6	1.3	2.6	.6														
300–9	—	.1	.2	.1	.2	.2	.2	.1													
310–9																					
320–9	.1	.1																			

pass. For this reason the single-point scale of the tally-sheets was changed to a scale in which the unit was a group of ten points. From this compressed table of actual numbers a corresponding table, presented herewith, was prepared to show the percentage of the whole number of employees on each date receiving each relative wage indicated by the scale on the left. The table is to be interpreted after the following fashion: "Of the 6,183 persons whose rates of pay are reported in July, 1880, 2.7 per cent. were then receiving relative wages, varying from 200 to 209 per cent. of the wages received by the persons holding their positions in 1860."

Discussion of the results shown by this table is not pertinent here. Our concern is solely with its effectiveness as a method of presenting changes in wages. Considered from this point of view, it has obvious advantages over any single set of averages. It prevents a careless or ignorant reader from getting the impression, often gotten from averages, that everybody had his wages changed in the degree indicated by the average. To the attentive reader it shows not only the general trend of wage-changes, but also the range and importance of the deviations from the general trend. But, on the other hand, the table does not give a clear idea of the degree of the changes from one date to the next. It would be tedious and perhaps difficult to decide from an examination of this table when wages reached their maximum and began to decline, when they reached their minimum and began to rise again. Nor would these facts be easier to ascertain from the frequency surfaces that might be drawn from the table. In short, tables and surfaces of frequency, while excellent for showing a complex distribution of measurements, suffer from the serious limitation that close comparisons between them are difficult to make. Therefore, they are ill-adapted for any work in which the chief point of interest is the comparison between the situation at different periods of time.

It is possible, however, to devise a modification of the table of frequency that avoids this defect of difficulty of comparison while retaining the merit of showing the range and distribution of fluctuations. Professor Dewey's form of the classified wage-table suggests how this may be done. The classified wage-table is itself a form of the table of frequency, and, like other forms, is found inconvenient to use in making comparisons. As said above, Professor Dewey reduced these difficulties by introducing into his tables columns of cumulative percentages, showing for each wage-rate the proportion borne by the number of persons receiving that rate or more to the whole number of persons included in the group. Since comparisons even between these cumulative percentages are difficult to make and leave no definite impression on the mind, Professor Dewey also introduced medians and quartiles into his tables. A specimen table from his report will make this method of presentation clear:—

Rates per Week (Dollars).	Actual Number.		Cumulative Percentage.		Position of Median and Quartiles.	
	1900.	1890.	1900.	1890.	1900.	1890.
Total	100	100				
5.00 to 5.49 . . .	30	6	100	100	Q	
5.50 to 5.99 . . .	10	10	70	94	—	
6.00 to 6.49 . . .	6	30	60	84	—	Q
6.50 to 6.99 . . .	2	2	54	54	—	
7.00 to 7.49 . . .	2	3	52	52	—	M
7.50 to 7.99 . . .	2	1	50	49	M	
8.00 to 8.49 . . .	29	9	48	48	Q	
8.50 to 8.99 . . .	10	10	19	39	—	
9.00 to 9.49 . . .	9	29	9	29	—	Q

Professor Dewey devised this form of table for presenting actual wages, but the plan can be readily adapted for use with relative wages. Such adaptation, however, requires certain modifications. (1) From Professor Dewey's tables the precise position of the medians and quartiles cannot be ascer-

tained. All that the tables show is the group within which they fall. It is true that these groups proceed by so small a unit of difference—50 cents in a week's pay—that the margin of uncertainty is perhaps negligibly small. But, were the same plan followed in treating relative wages having so wide a range of variation as during the period of the paper standard, publication in Professor Dewey's form would require the use of relatively large groups, and then the uncertainty of position would become serious. This difficulty can be avoided by determining the precise position of the median and quartiles on the long tally-sheets where the scale of relative wages proceeds by single points. (2) The definiteness of the exhibit can be increased by using not quartiles, but deciles, to supplement the medians. (3) It is also interesting to record the extreme range of the fluctuations. This can be done by giving the highest and lowest relative wage on each date. (4) These several quantities can be most readily compared if the columns showing the distribution of wage-earners and of cumulative percentages are dropped and columns showing highest and lowest relative wages, deciles, and medians placed side by side.

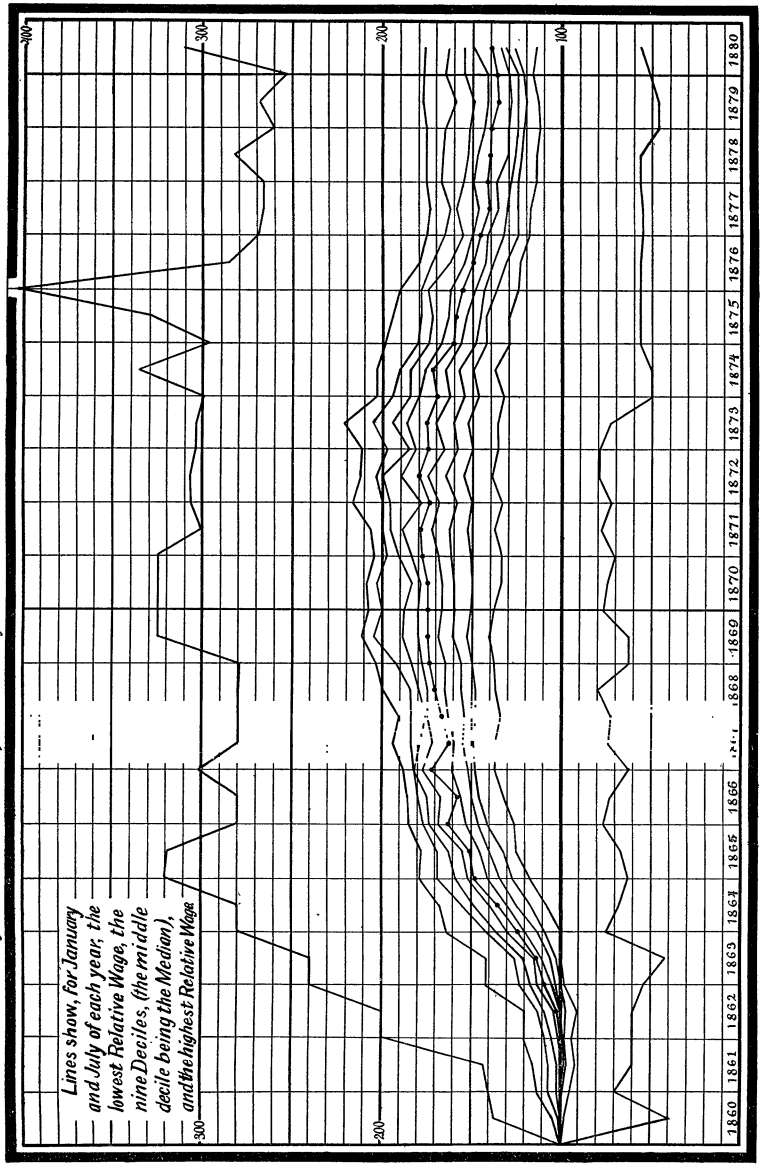
The table that follows has been constructed in this fashion from the same data as Table I. It shows, for example, that in July, 1880, the extreme range of wage-fluctuations, computed on the basis of wages in 1860, was from 57 to 311; that at least one-tenth of the employees included were getting relative wages between 57 and 115; that a second tenth were getting relative wages of 115 to 127; a third tenth relative wages of 127 to 132, etc. The chart accompanying the table shows the same facts in graphic form.

There are two features common to this table and to Table I to which objection may be made. First, relative wages are computed on the basis of actual wages on a single date; second, the numbers employed, of which the tables take account, are not constant averages, but the widely varying numbers of men and women reported as actually at work

TABLE II.

RELATIVE WAGES OF PERSONS EMPLOYED IN MANUFACTURING INDUSTRIES, 1860 TO 1880.

Date.	Number of Persons.	Lowest.	First Decile.	Second Decile.	Third Decile.	Fourth Decile.	Median.	Sixth Decile.	Seventh Decile.	Eighth Decile.	Ninth Decile.	Highest.
1860, Jan.	3,683	100	100	100	100	100	100	100	100	100	100	100
July	3,972	41	98	99	100	100	100	100	100	101	105	137
1861, Jan.	3,519	70	95	99	100	100	100	100	102	107	113	149
July	3,922	60	92	97	98	100	100	100	102	107	116	143
1862, Jan.	3,595	60	94	98	99	100	100	101	105	109	120	200
July	3,723	60	91	97	100	100	102	104	109	113	120	200
1863, Jan.	3,060	54	98	100	103	105	109	113	117	123	142	240
July	3,749	42	100	103	106	111	114	115	121	126	142	240
1864, Jan.	3,929	75	100	109	114	120	124	130	136	142	164	280
July	4,457	68	108	117	125	130	135	140	148	155	168	280
1865, Jan.	3,960	63	117	127	134	141	148	152	159	169	179	320
July	4,328	67	125	132	140	145	151	155	163	169	178	320
1866, Jan.	4,643	77	126	141	146	153	163	168	174	177	185	280
July	4,931	73	132	146	150	156	158	167	175	180	186	280
1867, Jan.	5,183	63	137	148	152	161	172	177	182	182	188	302
July	4,989	74	137	149	155	160	163	172	179	184	194	280
1868, Jan.	4,587	73	134	148	154	163	167	175	176	184	191	280
July	4,976	80	137	148	156	165	171	175	180	185	200	280
1869, Jan.	4,862	63	138	150	156	165	174	178	184	193	204	280
July	5,555	63	141	153	161	169	175	180	189	205	212	325
1870, Jan.	5,505	77	138	151	160	167	175	180	188	200	208	325
July	5,463	75	134	150	160	167	175	179	184	203	209	325
1871, Jan.	5,303	71	134	151	162	169	178	184	191	198	205	325
July	5,799	78	138	153	163	173	179	189	196	200	207	301
1872, Jan.	5,259	73	134	150	159	169	174	179	196	200	217	307
July	6,130	80	139	155	165	175	180	190	200	204	213	307
1873, Jan.	5,180	80	136	150	159	166	175	182	186	198	212	304
July	5,428	74	136	153	161	171	176	187	195	206	222	304
1874, Jan.	5,098	51	133	147	155	163	170	180	185	195	204	300
July	5,181	51	138	150	158	166	173	177	185	191	204	336
1875, Jan.	4,617	57	130	143	149	157	161	168	175	181	199	297
July	5,068	57	130	143	146	154	160	164	173	179	195	329
1876, Jan.	4,341	57	125	137	144	149	156	163	175	179	191	403
July	5,070	57	124	132	139	143	150	155	163	173	180	286
1877, Jan.	4,710	56	119	125	133	142	146	151	156	166	176	270
July	5,200	56	118	125	131	136	141	147	154	163	174	267
1878, Jan.	4,691	57	115	125	129	137	142	150	155	168	176	267
July	5,186	57	115	123	127	131	140	148	153	167	176	283
1879, Jan.	4,864	47	113	122	125	131	140	144	152	166	176	261
July	5,504	47	114	120	125	129	136	142	150	160	178	269
1880, Jan.	5,376	52	117	122	125	130	137	142	155	166	178	254
July	6,183	57	115	127	132	135	140	150	155	164	177	311


Relative Wages in Manufacturing Industries in the United States, 1860-1880.
Lines show, for January and July of each year, the lowest Relative Wage, the nine Deciles, (the middle decile being the Median), and the highest Relative Wage
300
200
100
1860 1861 1862 1863 1864 1865 1866 1868 1869 1870 1871 1872 1873 1874 1875 1876 1877 1878 1879 1880

on the successive dates. In most cases I think that average wages for a number of years afford a better basis for relative wages, and average numbers employed better weights. The reasons for departing from this general rule in the present case are found in certain special exigencies of the larger investigation, of which the study of wage-changes for which the tables were made forms a part. To explain these exigencies here would not only take too much space, but would also give no help toward forming an estimate of the merits of the novel features of the tables. For similar tables could be constructed from series in which ten-year averages were used for both bases and weights.

Waiving discussion, then, of these features, as well as of results, we see that Table II has certain advantages over both tables of frequency and ordinary averages. Compared with the latter, it is superior in showing more of the facts. One can learn from it, not only the general trend of wages, but also the range and distribution of the divergent fluctuations. No table of arithmetic or geometric means, of medians or modes based on the same data, could give so full a knowledge of the changes in wages during these years. Compared with tables of frequency, it is superior in showing distinctly the increase or decrease of wages from one date to the next. Though it does not show so clearly as do tables of frequency the concentration of numbers around certain points in the scale of relative wages, it allows such concentration to appear in the close approach and occasional identity of two deciles. Finally, it brings out more clearly than do tables of frequency the fact that, despite such concentration, the relative wages of four-fifths of the employees are distributed after the first few years over a range of some 50 to 80 points, with but a slight increase in density toward the median.*

* The relative density of the distribution in different parts of the field covered by the fluctuations may be measured by the number of points in the wage-scale separating the several deciles from each other and the first and ninth deciles from the

It need hardly be said that this method of presentation can be used in dealing with many kinds of statistics besides those to which it is here applied. Its general use would make it easy to cultivate a field of statistical investigation at present neglected by economists; namely, differences in the uniformity and range of fluctuations characteristic of such groups, for example, as wholesale and retail prices. With the methods of presenting statistics now commonly used, the investigator gets from his material knowledge only of difference in general trend and in average degree of change. By this method, differences hardly less interesting might often be shown to exist in the degree of variability of certain measurements in the case of different groups. The use of the device in dealing with all sorts of data is facilitated by its flexibility in possible degree of refinement in detail. If deciles are too elaborate for a given purpose, one can confine the detail to medians and quartiles. If deciles are insufficient, one can use centiles.

Only two drawbacks to the device occur to me. First, more labor is required to prepare such a table than to compute a series of medians or arithmetic means. And more effort is also required of the reader in studying such a table. Whether the additional labor is well expended or not depends in each case on whether a relatively thorough knowledge of the facts is worth having. Second, a presentation of the facts so full as this form of table gives is embarrassing when one is making simple comparisons or stating general

lowest and highest relative wages. The following figures show the averages of such measurements for the whole period:—

Between the	lowest relative wage and the first decile	57.2	points
" "	first and second deciles	10.0	"
" "	second and third "	5.7	"
" "	third and fourth "	5.9	"
" "	fourth decile and the median	5.4	"
" "	median and the sixth decile	5.3	"
" "	sixth and seventh deciles	6.4	"
" "	seventh and eighth "	7.5	"
" "	eighth and ninth "	10.6	"
" "	ninth decile and the highest relative wage	96.7	"

conclusions. For such purposes an average of some sort is more convenient because it is simpler. However, such tables furnish their own averages—the medians—for such uses; and they safeguard these averages by showing how far they may be accepted as a brief representation of all the facts. When the medians are not satisfactory averages for such uses, arithmetic means or modes can readily be found by using the tally-sheets made to find the position of the deciles. The device is not suggested to supplant averages, but to supplement them.